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(54) **CONTROL DEVICE FOR LASER DIODES**

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Related U.S. Application Data

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(30) **Foreign Application Priority Data**

Sep. 30, 1999 (DE) 199 48 689

(51) **Int. Cl.**[7] **H01S 3/13**
(52) **U.S. Cl.** **372/29.011**; 372/38
(58) **Field of Search** 372/29.011, 38; 350/205; 347/129; 455/609

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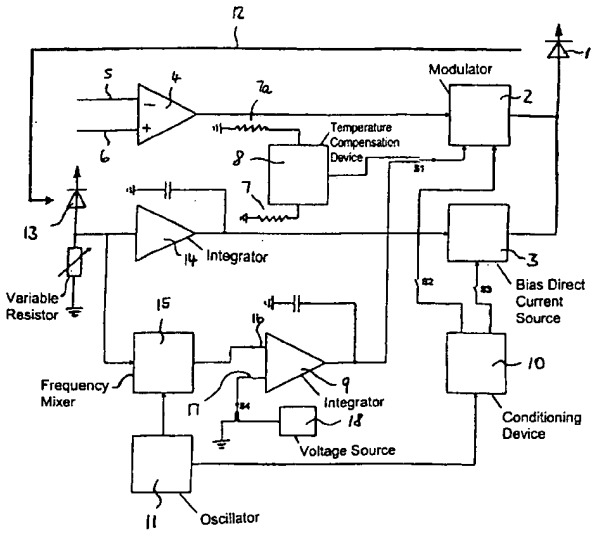
(57) **ABSTRACT**

A device for adjusting laser diodes includes a pilot signal adjustment device for adjusting the signal current using a pilot signal frequency that is modulated onto the signal current. The device includes a bias direct current source supplying the laser diode with a bias direct current. A switching device switches the adjustment device between a state where the pilot signal adjustment device is connected to the modulator and the bias direct current source such that the signal current can be adjusted using the pilot signal adjustment device, and another state where the modulator is connected to the temperature compensation device such that the signal flow can be adjusted and/or controlled by the temperature compensation device.

13 Claims, 1 Drawing Sheet



US-PAT-NO: 6643301

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TITLE: Control device for laser diodes

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Abstract Text - ABTX (1):

A device for adjusting laser diodes includes a pilot signal adjustment device for adjusting the signal current using a pilot signal frequency that is modulated onto the signal current. The device includes a bias direct current source supplying the laser diode with a bias direct current. A switching device switches the adjustment device between a state where the pilot signal adjustment device is connected to the modulator and the bias direct current source such that the signal current can be adjusted using the pilot signal adjustment device, and another state where the modulator is connected to the temperature compensation device such that the signal flow can be adjusted and/or controlled by the temperature compensation device.

TITLE - TI (1):

Control device for laser diodes

Brief Summary Text - BSTX (3):

The invention relates to a control device for a laser diode. The control device includes a bias direct current source supplying a bias direct current to the laser diode. The control device includes a modulator for modulating a signal current for the laser diode in accordance with a data signal received by the modulator. The control device also includes a

temperature compensation
device that can be connected to the modulator such that the signal current can
be regulated and/or controlled as a function of temperature changes.

Brief Summary Text - BSTX (4):
Laser diodes are used for the fast transmission of digital, optical signals,
in particular, because they have a narrow spectral width and the capacity for
fast modulation. In the case of such laser diodes, deviations from a
predefined characteristic curve occur during operation, depending for example,
on the age of the laser diode or on the temperature. Depending on how the
laser diode is used, various control mechanisms are used in order to compensate
for the deviations from the characteristic curve.

Brief Summary Text - BSTX (5):
These control mechanisms include using a temperature compensation device.
Regulation of this type is necessary since the current threshold value I.sub.s
of the characteristic curve of a laser diode, at which the characteristic curve
changes from a region of the bias direct current (no light emission) into a
region of the signal current (light emission region), is temperature dependent.
Using the temperature compensation device, the bias direct current of the laser
diode can be regulated in such a way that the laser diode always operates in
the region of the signal current. The disadvantage of this type of control is
that no regulation of the modulated signal current is carried out, so that, for
example, changes in the characteristic curve, in particular with regard to the
slope as a consequence of the aging of the laser diode, or on account of
temperature changes, cannot be compensated for. The influence of such

characteristic curve changes can be reduced, preferably ruled out, by using a
pilot tone control device.

Brief Summary Text - BSTX (6):

A pilot tone control device is known, for example, from the publication by
D. W. Smith and T. G. Hodgkinson entitled, "Laser level control for optical
fiber systems with high bit rate", symposium, Houston, April 1980. A
distinction is drawn between pilot tone control to the high level of the signal
current from the laser diode and pilot tone control to the high and the low
level of the signal current. In principle, in this case a pilot tone frequency
is modulated onto the signal current (pilot tone control on the high level) or
onto the signal current and the direct current (pilot tone control on the high
and the low level). Using a monitor diode, part of the light emitted is
registered. The registered part of the light is evaluated in order to carry
out a readjustment in the event of deviations with regard to the mean output
power of the laser diode and the pilot tone amplitude. The disadvantage with
pilot tone control to the high and the low level is that at high data rates,
because of the modulation of the signal current in the region of the threshold
current I.sub.s, at which the characteristic curve of the laser diode bends,
jitter is promoted. This can be avoided by using pilot tone control at the
high level of the signal current.

Brief Summary Text - BSTX (8):

It is accordingly an object of the invention to provide a control device for
a laser diode which overcomes the above-mentioned disadvantages of the prior
art apparatus of this general type.

Brief Summary Text - BSTX (9):

In particular, it is an object of the invention to provide a control device for a laser diode with which the possibilities of using the various control mechanisms are improved.

Brief Summary Text - BSTX (10):

With the foregoing and other objects in view there is provided, in accordance with the invention, a control device for at least one laser diode, including: a bias direct current source connected to the laser diode and providing a bias direct current to the laser diode; a modulator for modulating a signal current for the laser diode in accordance with a data signal received by the modulator; a temperature compensation device switchably connected to the modulator such that the signal current can be operated on, as a function of temperature changes, in a manner selected from the group consisting of being regulated and being controlled; a pilot tone control device for controlling the signal current by modulating a pilot tone frequency onto the signal current; and a first switching device for switching between a first state and a second state. In the first state, the pilot tone control device is connected to the modulator and the bias direct current source such that the signal current can be regulated using the pilot tone control device. In the second state, the modulator is connected to the temperature compensation device such that the temperature compensation device operates on the signal current in a manner selected from the group consisting of regulating the signal current and controlling the signal current.

Brief Summary Text - BSTX (18):

In accordance with yet an additional feature of the invention, the control device controls a plurality of laser diodes.

Brief Summary Text - BSTX (21):

The object of the invention is achieved by providing a pilot tone control device for controlling the signal current by modulating a pilot tone frequency onto the signal current, and also by providing a switching device for switching the control device between one state and another state. In one state, the pilot tone control device is connected to the modulator and the bias direct current source such that the signal current can be regulated using the pilot tone control device. In the other state, the modulator is connected to the temperature compensation device such that the signal current can be regulated and/or controlled using the temperature compensation device.

Brief Summary Text - BSTX (22):

The substantial advantage achieved with the invention as compared with the prior art consists in the fact that by using a single control device, the benefit of two of the above-described different control mechanisms for laser diodes can be used. Depending on the particular application, it is therefore possible for the control mechanism beneficial to the application to be selected and used.

Brief Summary Text - BSTX (29):

In an expedient refinement of the invention, the laser diode is replaced by an arrangement of a plurality of laser diodes, as a result of which, the control device can be used, for example, for laser diode arrangements for transmitting a plurality of parallel, optical signals.

Brief Summary Text - BSTX (31):

Although the invention is illustrated and described herein as embodied in a control device for laser diodes, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

Drawing Description Text - DRTX (2):

The sole drawing FIGURE shows a laser diode and a control device for controlling the laser diode.

Detailed Description Text - DETX (2):

Referring now to the sole drawing FIGURE in detail, there is shown a laser diode 1 that is connected to a modulator 2 and to a bias direct current source 3. The direct current bias source 3 applies a bias direct current to the laser diode 1, so that by using a modulation current, which is generated by the modulator 2, the laser diode 1 can be operated in a characteristic curve region that begins at a threshold current I.sub.s. The modulation current is generated in the modulator 2 in accordance with a data signal that the modulator 2 receives from an input stage 4, which has an inverting input 5 and a noninverting input 6. The modulator 2 can be adjusted in terms of amplitude, for example, by using an external resistor 7.

Detailed Description Text - DETX (3):

The control device illustrated in FIG. 1 enables three different control mechanisms to be applied to the laser diode 1. Switches S1 to S4 are used to select one of the various control mechanisms such that the selected control

mechanism is used when controlling the laser diode.

Detailed Description Text - DETX (4):
In a first application, the modulator 2 is connected to a temperature compensation device 8 by the switch S1. The switches S2 and S3 are open in this case. The temperature compensation device 8 enables shifts in the characteristic curve of the laser diode 1, for example with regard to the slope, to be compensated for using the modulation current. To this end, the temperature compensation device 8 has, in particular, a temperature sensor. A temperature coefficient of the modulation current can be adjusted by using a further external resistor 7a.

Detailed Description Text - DETX (6):
A portion of the optical signal emitted by the laser diode 1 is transmitted to a monitor diode 13 via optical feedback 12 and is converted into an electrical monitor signal. The monitor signal is transmitted to a second integrator 14 and to a frequency mixer 15. The second integrator 14 amplifies the monitor signal and supplies a control signal to the bias direct current source 3 so that the bias direct voltage that is transmitted to the laser diode 1 is regulated. A lower limiting frequency of this control circuit must be lower than the pilot tone frequency which, for example, is 3 kHz and is therefore substantially lower than the normal modulation frequencies of the modulation current which, for example, may be 100 kHz to more than 1 GHz.

Detailed Description Text - DETX (9):
The control device illustrated in FIG. 1 can be constructed as an integrated circuit that is connected to a laser diode 1 or a

configuration of a plurality
of laser diodes. Depending on the application for which the laser diode 1 or
the laser diode configuration will be used, one of the above-described control
mechanisms can be selected by appropriately setting the switches S1 to S4,
during the programming of the integrated circuit. In this way, the integrated
circuit can be adapted to various applications.

Claims Text - CLTX (1):

1. A control device for at least one laser diode, comprising: a bias direct
current source connected to the laser diode and providing a bias direct current
to the laser diode; a modulator for modulating a signal current for the laser
diode in accordance with a data signal received by said modulator; a
temperature compensation device switchably connected to said modulator for
controlling the signal current as a function of temperature changes; a pilot
tone control device for controlling the signal current by modulating a pilot
tone frequency onto the signal current; and a first switching device for
switching between a first state and a second state; in said first state, said
pilot tone control device being connected to said modulator and said bias
direct current source for regulating the signal current using said pilot tone
control device; and in said second state, said modulator being connected to
said temperature compensation device causing said temperature compensation
device to control the signal current.

Claims Text - CLTX (11):

11. The control device according to claim 1, wherein the at least one laser
diode defines a plurality of laser diodes.

Other Reference Publication - OREF (1):
Smith, D. W. et al.: "Laser Level Control for High BIT Rate Optical Fibre
Systems", XP-000955403, IEEE, 1980, pp. 926-930.